

# FIBER-WATER— WATER CONTAINING SOLUBLE FIBER

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present application concerns generally components of the human diet and more specifically water and fiber.

### 5 2. Description of Related Art

Many of the major problems in human health revolve around which dietary components are truly essential for animal and human health and which components are merely hyped by various companies to sell product. A related problem is that of the accuracy of information regarding the appropriateness of a given food, nutrient or  
10 nutraceutical for a given individual. Certainly the "one size fits all" scenario is untrue when it comes to drugs and nutrition. Further, the Federal Drug Administration has very little control over dietary supplements so that companies compete in making claims and launching new products, which may or may not be helping humans or animals that consume the products. New information constantly comes forth warning of potential  
15 interactions between herbal supplements, ethical pharmaceuticals and various disease states. The present inventor is concerned with providing a composition that can be extremely beneficial to humans and animals with few, if any, dangers or drawbacks. In the following description consumption by humans should also be taken to include consumption by domestic animals—primarily dogs and cats. While many of the concepts  
20 discussed are applicable to other animals, the digestive systems of herbivores, particularly ruminates, varies tremendously from that of humans. Therefore, the thrust of the present

invention is towards carnivores and omnivores whose digestive systems more closely resemble those of humans.

One of the conundrums of human health is that dietary components may appear mundane are actually incredibly essential. One such vital component that is frequently overlooked or given insufficient importance is water. Although water is not metabolized, it is absolutely essential for metabolism. A majority of the weight of the body is water which serves as the solvent for the chemical reactions of life. Many living cells are more water than anything else. The various nutrients needed for cellular growth and survival enter the cells dissolved in water. After metabolism, the waste products are carried away by water. Death can occur in as little as three to five days without water.

It is generally agreed that the average person should consume at least eight 8 oz. glasses of water per day—more if the individual is undergoing stress that leads to increased loss of water. Unfortunately, most people drink water, or appropriate hydrating drinks, only when they feel parched. Generally, they do not consume sufficient water to completely reverse dehydration. Further, this thirst response becomes even less effective as one ages. Older people are less likely to drink sufficient water and are more likely to suffer from dehydration. The reader's attention is drawn to "Problem: thirst, drinking behavior, and involuntary dehydration" by John E. Greenleaf (Medicine and Science in Sports and Exercise, 24:645 (1992)).

When the body is dehydrated, nutrients cannot be as readily delivered to the cells. When the body is dehydrated, waste products cannot be as readily removed from the cells. With dehydration viscosity of the blood is increased so that efficiency of circulation is decreased. Such impaired circulation can ultimately lead to vascular damage and disease. At the same time because the dehydrated body seeks to reverse this situation, more water is removed from the bowel. This causes excessive compaction and hardness of digestive residues with resulting constipation and potential accumulations of toxins in the bowel

(which toxins may ultimately be absorbed into the blood stream). Further, there is abundant evidence that constipation may lead to cancer of the colon possible as a result of prolonged contact between cells of the colon and toxin laden feces.

Because of the dehydrated situation of the body, filtration of wastes by the kidneys is reduced resulting in an even more significant buildup of toxic or waste products in the circulation. These wastes can exacerbate vascular damage while the high osmotic level of the blood and the high level of waste products can actually result in kidney damage. Of course, damaged kidneys are even less able to remove wastes and toxins. This results in a "chain reaction" where even more toxins and wastes accumulate and the overall damage becomes greater and greater.

Adequate intake of safe water can the basic problems of dehydration. By "safe water" is meant water that meets the safety standards for drinking water promulgated by the federal and state governments in the United States. In other countries appropriate governmental entities set the standards for "safe water." However, even with an adequate intake of water constipation and the damage it engenders continue to be a significant problem. This is due, in a large part, to the life style and diet of our industrialized society. Many people do not get the optimal amount of physical activity. Such activity is important in stimulating proper functioning of the digestive tract. Further, even with adequate exercise and intake of water, it is important that the food consumed have adequate "roughage."

Unquestionably as a society, we are suffering from a deplorable lack of dietary fiber. We are constantly warned by the medical profession and other experts that this lack of fiber can and does kill. Our diets are replete with "empty" calories—refined foods loaded with fats and sugars—and contain few whole foods. When it comes to fiber many believe that a daily bowl of cereal is adequate. Our supermarkets and pantries are stuffed with brightly packaged prepared foods that are usually fiber-free or very low in fiber. The

presence or absence of dietary fiber greatly influences one's ability to expel solid wastes. About one in 19 individuals in our society has a health condition that requires special attention. This makes the need for adequate fiber even more important to many of these individuals. Due to modern medicine's success in combating contagious disease we are  
5 living longer and longer. But can we live healthier with calorie-laden over processed refined foods that lead to obesity? People try to cure these problems with miracle diets and by consuming a number of supplements in an attempt to replace what refining has removed from food.

Fiber or "roughage" is a component of food that remains undigested as it passes  
10 through the gastrointestinal system. The vast majority of dietary fiber consists of polysaccharides of plant origin. The most obvious fiber is the cellulosic wall that surrounds plant cells. Many of these cells are actually called "fibers" hence the original name of this component. However, there are actually two forms of fiber: insoluble fiber — the classic cellulosic material, and soluble fiber—water soluble polysaccharides that are  
15 not digested by human or carnivore digestive systems. Both types of fiber bind considerable water and, thus, have a softening effect on the stool. However, soluble fiber may, depending on the precise polysaccharides involved, may be metabolized or partially metabolized by bacterial in the colon. Thus, soluble fiber may not have the same bulking effect on the stool. Both type of fibers tend to increase motility within the gastrointestinal  
20 tract thus speeding transit time of wastes and lowering the risk of colon cancer. Like water fiber is essential for human health and is not metabolized by humans.

It has been discovered that dietary fiber appears to moderate the rate at which sugars and fats are absorbed from the intestine. The exact reason for this effect is not completely understood. Perhaps the fiber somehow sequesters these materials and thus  
25 slows or prevents absorption. Perhaps by speeding the overall transit of material through the digestive tract, absorption is slowed. In the case of simple sugars slowed absorption

translates to a more gradual rise in blood sugar following eating. This is likely important in the managing of diabetes and may also help prevent adult onset diabetes. In the case of fats the fiber seems to help prevent damaging levels of cholesterol in the blood. This may be due to a binding of bile salts and cholesterol to the fiber so that these materials are excreted with the feces rather than being absorbed or reabsorbed. Adequate fiber clearly lowers the risk of heart disease. Further, fiber tends to bind toxic metals and other toxins for safe transit out of the digestive system.

In fact, it has been suggested that deficiency in dietary fiber is related to numerous disease states including colon cancer, heart disease, cerebral apoplexy, appendicitis, and diabetes. This is apart from those diseases more closely linked to constipation such as intestinal toxemia, hemorrhoids, irritable bowel syndrome, colitis, diverticulitis, varicocele, and cholelithiasis (gall stones). It is believed that dietary fiber performs various useful physiological functions including reduction of serum cholesterol, limitation of insulin secretion, and acceleration of bowel evacuation. All these factors make fiber a very important nutrient substance, the sixth most important by some commentators, although it is not actually metabolized.

It would appear that any water-soluble non-metabolizable carbohydrate polymer could act as dietary fiber. It is important that no human enzymes are capable of hydrolyzing these polysaccharides into simple sugars that would readily absorbed so that the material would not provide a "fiber" effect. Preferentially, the polymers should also not be readily metabolized by bacteria common in the human gut because if bacteria do not metabolize them they will continue to provide a "bulking" effect. Further, carbohydrates of certain legumes such as beans are infamous for being readily metabolized by gut bacteria with unfortunate results. However, some types of soluble fiber are metabolized by and do promote growth of beneficial bacteria. This generally has a positive

effect as the beneficial bacterial also tend to lubricate the stool and prevent the growth of other bacteria that may release toxins.

Soluble fiber comes from a wide range of plant sources. Water-soluble plant pectins and pectic materials, galactomannans, arabanogalactans and water-soluble hemicellulose can act as soluble fiber. Many plant "mucilages," gums, and soluble polysaccharides found in grains, seeds, or stems such as psyllium, guar, oat (beta glucans), astragalus (gum traganth), gum ghatti, gum karaya (*Sterculia* gum), and gum acacia are also soluble fiber. Algal polysaccharides such as agar or carrageenan also behave as soluble fiber as do other indigestible carbohydrates, such as maltodextrins or dextrins, produced by chemical or enzymatic digestion (*e.g.*, partial hydrolysis) of starch, gums and other carbohydrate polymers. Soluble cellulosic ethers and other derivatives such as carboxymethyl cellulose behave as soluble fiber as do indigestible carbohydrate polymers artificially prepared using bacterial enzymes. Non-digestible storage carbohydrates such as inulin are also important soluble fibers. A number of companies are now providing an entire range of "soluble fiber" materials. For example, TIC Gums of Belcamp, Maryland, Novartis Nutrition of Minneapolis, Minnesota and Imperial Sensus of Sugar Land, Texas provide soluble fiber compounds of food grade.

Soluble "fiber" is known to provide a novel opportunity for improving the characteristics of fiber-poor refined foods. Fiber was removed from food products because in many cases it made the foods coarse, unpalatable or difficult to process. Adding insoluble bran or other similar fiber to foods may provide more roughage but can also degrade the favorable properties of the foods. For example, cakes or pastries made from flours high in insoluble fiber may have inferior taste and texture. Excess insoluble fiber may upset the digestion and lead to a number of digestive problems. On the other hand, soluble fiber is generally well tolerated, often improves the texture or other physical characteristics of the food product and is generally innocuous. Consequently, there are a

growing number of food products, ranging from baked goods to "shake-like" beverages, contain added fiber in the form of soluble fiber. Soluble fiber can restore the benefits of fiber to our highly refined diet.

There are a number of "medical" or laxative products on the market that are based on soluble fiber. Various different brands are based on psyllium seed carbohydrates or on soluble cellulose derivatives (*e.g.*, carboxymethyl cellulose). These products are replete with sugar, colors, dyes, artificial flavors, and artificial sweeteners. Generally, they do not comfortably fit into a "normal" diet.. Usually they are powders that must be mixed with water to make a more or less thick, murky, slimy or even gritty solution. Further, their directions are rife with warning such as "TAKING THIS PRODUCT WITHOUT ADEQUATE FLUID MAY CAUSE IT TO SWELL AND BLOCK YOUR THROAT OR ESOPHAGUS AND MAY CAUSE CHOKING. DO NOT TAKE THIS PRODUCT IF YOU HAVE DIFFICULTY IN SWALLOWING, IF YOU EXPERIENCE CHEST PAIN, VOMITING, OR DIFFICULTY IN SWALLOWING OR BREATHING AFTER TAKING THIS PRODUCT SEEK IMMEDIATE MEDICAL ATTENTION."

Despite the tremendous benefits of soluble fibers such a warning points out that dry packaged soluble fiber products are not the safest way to obtain soluble fiber. Fluid ingestion is an important, even vital, part of consuming soluble fiber. Further such a warning makes it clear that a safe and effective means for administration of soluble fiber is still needed because many consumers routinely disregard label directions and warnings.

### SUMMARY OF THE INVENTION

It is an object of the present invention to simultaneously provide both essential water and essential dietary fiber.

It is another object to safely provide an optimal combination of water and fiber —  
5 two essential elements of human health.

It is a further object of the present invention to provide soluble dietary in a form that guarantees that adequate water accompanies the fiber to render it optimally functional.

It is another object of the present invention to provide fiber and safe water in a simple and pleasant to ingest format.

10 The present invention discloses a water-like fluid that contains safe water and a significant quantity of soluble dietary fiber. The resulting solution is generally optically clear and has physical properties similar to potable water. The fluid is intended as a replacement for bottled or other water as a means to ensure proper hydration. Depending on the soluble fiber used the fluid is either non-caloric or extremely low in calories. The  
15 amount of soluble fiber is adjusted so that consumption of an adequate amount of fluid to ensure hydration (e.g., eight 8 oz. glasses per day) will also provide an optimal amount of dietary fiber. This is particularly valuable in stressed situations where the diet may not provide adequate fiber without supplementation. The constant metered supply of fiber provided throughout the day may be preferable to and more convenient than "bolus"  
20 administration of fiber through laxatives, etc. Additionally, the constant presence of soluble fiber in the digestive tract provides the known beneficial effects of moderating the postprandial increase in blood glucose, modulating serum lipid levels, and suppressing appetite.

The present invention is prepared by dissolving any of a number of water-soluble polysaccharides in safe potable water. Either purified water or natural water (*e.g.*, mineral water) can be used. However, because hydration is a major object of the invention, the base water should be relatively low in dissolved salts. Preferably the base water will not  
5 contain more than about 500 mg./l dissolved salts. Especially preferred polysaccharides are refined dextrans or maltodextrins produced from hydrolysis of starch (*e.g.*, corn or potato starch, purified inulins (fructo-oligosaccharides) produced from plants such as dahlia or chicory, and partially hydrolyzed or otherwise fractionated vegetable gums such as partially hydrolyzed guar gum. A single or mixtures of several polysaccharides can be  
10 used depending on the precise use. The polysaccharides should be essentially indigestible although colon bacteria may metabolize them. If bacteria metabolize them, care should be taken that they are fermentable only by benign and beneficial bacteria.

One way of using the invention is to provide the proper daily requirement of fiber spread over the eight 8 oz. glasses of water recommended to insure proper hydration. The  
15 invention is also useful to provide fiber and water in enteral feeding situations and to provide fiber to children and infants. In some applications color may be added as an indicator of the amount of fiber present because different strengths of the fiber solution are contemplated. The material can be consumed directly or can be used in any food to which water must be added. It is also contemplated that the invention can be used to ensure  
20 hydration and regularity of domestic animals—primarily cats and dogs. However, any carnivore or omnivore should benefit from the invention. Herbivores have very different gut bacteria and may be able to metabolize the soluble fiber. Therefore, these animals must be tested on a case by case basis.

DETAILED DESCRIPTION  
OF THE PREFERRED EMBODIMENTS

5 The following description is provided to enable any person skilled in the art to make and use the invention and sets forth the best modes contemplated by the inventor of carrying out her invention. Various modifications, however, will remain readily apparent to those skilled in the art, since the general principles of the present invention have been defined herein specifically to provide a water-like drink containing significant amounts of soluble fiber.

10 The current trend in foods is to add fiber and soluble fiber to a variety of food products. There are, however, potential drawbacks to this trend. To be fully effective soluble fiber must be combined with an adequate intake of water—certainly not available in dry goods and baked goods. This is true for both soluble and insoluble fiber. Although the "shake-like" and other soluble fiber beverages or mixes to which water must be added do contribute water, they, like most dry goods, also contribute a significant source of  
15 calories to the diet—a major problem with today's diets and something clearly not needed by our generally overfed population. While it is possible to limit the caloric content of the fiber-containing beverages through the use of non-nutritive sweeteners, this amounts to adding chemicals that may create or exacerbate health problems. Therefore, the present inventor has developed a superior solution based on the unique synergistic interaction  
20 between water and soluble fiber.

In experimenting with various types of soluble fiber, the inventor noticed that a number of the more refined materials, such as lower molecular weight grades of inulin (for example see U.S. Patent No. 5,968,365), specialized dextrins, maltodextrins and partially hydrolyzed guar gums can actually produce a clear, or virtually clear, and  
25 virtually colorless solution in water. Further, these soluble fibers are essentially tasteless at

the preferred concentrations for consumption and essentially non-metabolized by the human digestive tract.<sup>1</sup> Thus is produced an entire new class of beverage—namely, "**fiber-water**." Dissolving appropriate water-soluble fiber to a concentration of generally 1-10% (by weight) produces **fiber-water**. The resulting product is essentially water-like.

- 5 Any of the soluble fiber materials listed above can be combined so long as the resulting product has the desired "water-like" characteristics—namely little or no taste, water-like viscosity, and few or no calories. Some of the carbohydrate polymers may contain small amounts of material that is absorbed and does contribute calories to human metabolism. However, the number of calories is small compared to the significant dietary fiber
- 10 contributed and can be minimized by careful selection and blending of different soluble fiber materials.

- Fiber-water** is the perfect addition to the modern human diet as well as that of appropriate animals. It adds few, if any, calories and is readily substituted for bottled water as a safe source of hydration. In the intestines water is withdrawn from the intestinal
- 15 contents, and as the effective concentration of soluble fiber increases the viscosity increasing and sequestering properties of the soluble fiber result in slowed absorption of sugars and altered absorption of fats. This is of major significance in diabetes, heart disease and certain other health conditions. Ultimately in the colon the hydrophilic properties of the soluble fiber have a softening and bulking effect on the stool. Thus,
- 20 **fiber-water** is a unique, consistent, safe, easy to use single product that simultaneously

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<sup>1</sup> Many of these materials contain a small component of metabolizable carbohydrate. For example, inulins often contain about 1.6 food calories per gram. This is a tiny fraction of the calories provided by a fully metabolizable carbohydrate. In many cases the exact amount of carbohydrate absorbed varies from person to person depending on age, weight, health condition, etc. The exact number of calories absorbed can be discovered only by careful metabolic analysis. However, the maximum number of absorbed calories will not exceed the maximum given for a specific fiber type (e.g., 1.6 food calories per gram for a specific inulin).

ameliorates the problems of dehydration and constipation. Further, there are indications that the viscosity enhancing and carbohydrate absorption-slowing properties of the soluble fiber result in appetite suppression both by creating a feeling of fullness and by moderating swings in blood sugar. The literature is filled with positive effects of fiber on weight control both in humans and domestic animals. Thus, the material is not only non-caloric or very low caloric but has additional positive effects on weight control.

Although the inventor contemplates **fiber-water** as a direct way to add water and fiber to the diet, it is also a feature of the invention that it can also be used to add fiber to other foods. For example, any packaged food or beverage can be reconstituted with **fiber-water** to yield a fiber-enhanced food. Because **fiber-water** is based on safe water, it results in a safe food product even if the product is not heated to destroy microbes, although soluble fiber polysaccharides are generally stable during the cooking process. This means that if **fiber-water** is used to cook foods, such as grains (rice), oatmeal, and legumes, that imbibe water during the cooking process, these foods will also become fiber enhanced. Fiber can readily be added to all types of packaged food including gelatin products and to canned concentrated foods such as soups. Further, since **fiber-water** is heat stable it can be used to prepare fiber enriched hot beverages. In addition, it can be frozen to provide "fiber ice cubes."

An important aspect of **fiber-water** is that it preferably has a "water-like" appearance. By this the inventor means that the solution is essentially clear. People tend to relate clear solutions to purity. Some soluble fiber materials yield a cloudy or murky solution. It is preferred that **fiber-water** utilize materials that yield essentially clear solutions. As already mentioned, several available non-digestible carbohydrates produce "water clear" solutions. Generally partial hydrolysis or fractionation of the soluble fiber materials already discussed (*e.g.* partially hydrolyzed guar gum) will lead to clearer solutions. To date many manufacturers of soluble fibers have been concerned with using

their products in solid foods where texture of the ingredient is most important. Therefore, there has been little effort in producing materials that make clear solutions.

Besides universal use as a hydrating and fiber providing material **fiber-water** is especially useful in situations of stress. It is believed that stress, both physiologically and psychologically wrecks havoc on the body and alters or effects bowel regularity. When  
5 under stress humans and animals are known to reduce their consumption of water. When the body is stressed by disease it actually requires additional water yet this is exactly when many reduce their fluid intake. Further stress may influence people to prefer sugar laden beverages (comfort food) or caffeine beverages for alertness—these types of beverages  
10 actually increase ones water requirement and may lead to dehydration. Thus, it is beneficial to provide **fiber-water** as opposed to plain water in emergency supplies to be used in case of natural disaster—fire, flood, storm, earthquake, or hurricane. During such an disaster people are stressed and are often forced to move from their homes. Emergency situations often dictate a shortage of food and/or food will be available at abnormal times.  
15 Bathroom facilities are often limited or inconvenient. This combined with the general shortage of fresh fruits and vegetables, which are a key source of dietary fiber, during such an emergency naturally leads to loss of regularity. Emergency food drops rarely contain fresh fruits and vegetables. Having to deal with the emergency is bad enough. Adding severe constipation and dehydration simply makes a bad situation worse. Assuring  
20 ample supplies of **fiber-water** alleviates many of these problems.

Natural catastrophes and emergencies are certainly a source of stress as are medical problems. Numerous and varied medical condition, both short tem and long term, may require feeding an individual through a tube. The two types of tubes used most commonly are the naso-gastric tube and the gastrostomy tube. In either case nutriment is  
25 supplied directly into the stomach. Great efforts have been made by major corporations to provide good nutritional products for tube feeding. Depending on the design of the

particular tube, viscosity of the feeding liquid may be a problem. The present inventor is a named inventor on U.S. Patent Numbers 4,315,513 and 4,393,873 for valve-containing percutaneous tubes and is an expert on the potential problems of tube feeding.

Depending on the specific medical condition and/or severity of the problem, dehydration and constipation may remain constant problems. Sufficient hydration and more specifically the ingestion of sufficient water are most often a problem. Nasal tubes often irritate the throat. Even though there have been continuing efforts to create tube feeding formulae, commercial products are often low in fiber. Also, liquid foods capable of passing through a tube are frequently high in calories and low in fiber. Some patients may have a high requirement for calories but others do not. Therefore, one may administer excess calories in an attempt to provide adequate fiber. The solution is to supplement the feeding regime with **fiber-water** rather than plain water. **Fiber-water** as described herein is very low in viscosity so that it is simple to administer. For hospital use the inventor contemplates providing **fiber-water** in a number of different grades—that is with different quantities of fiber. In this way a grade can be selected that will provide the optimum amount of fiber to a given patient when the quantity administered is adjusted to meet the patient's hydration needs. It is further contemplated that the grades could each be uniquely colored with a safe soluble food-grade color so that hospital personnel or other caregiver could readily recognize which grade of **fiber-water** was being administered. This would further ensure that the correct grade was used for a particular patient. Additionally, color might be pleasing to the patient, especially to a child patient, and distract from an unpleasant situation. Further, these tubes are not always permanent, and if the **fiber-water** experience is pleasant and convenient perhaps new drinking habits will be instilled and carried forward.

Although the above discussion presupposes that the primary user of **fiber-water** would be an adult, children and infants, as well, have significant fiber requirements.

Children, as well as adults, are victims of the American diet, which is notoriously deficient in fiber rich fruits and vegetables. Consciously or not, many parents have taught their children to reject foods that are brown, speckled or have significant textures. It is important that parents, as care givers, become aware of the amount of fiber consumed by their children. Children can benefit from optimal hydration based on **fiber-water**. By helping control appetite it may help control childhood obesity. It may even be of aid with eating disorders such as anorexia or bulimia since victims of these disorders are known to drink water because it lacks calories. **Fiber-water** would at least help preserve proper functioning of the gastrointestinal tract while other treatment is undertaken.

At every stage of life fiber is vital to proper health and growth and development. Infants and toddlers require a regular and controlled source of fiber. After babies cease to breast-feed or use liquid formulas and move on to more varied "adult" solid foods, they often suffer a number of painful digestive episodes which makes them fussy and difficult. **Fiber-water** provides an ideal source of hydration for such infants because not only does it ensure adequate hydration, it also provides a consistent fiber source to guarantee regularity. It should be kept in mind that typical commercial baby foods may vary widely in the amount of fiber provided. **Fiber-water** provides an opportunity to lay the foundation of good habits of hydration and fiber intake.

Domestic animals, particularly cats and dogs, also suffer from problems with hydration and constipation. Dogs are omnivorous and will naturally consume some fruits and vegetables. However, refined dog foods tend to be remarkably deficient in vegetable fiber. Administering a source of fiber-water daily since dogs generally drink offered water can readily alleviate this problem. An alternative is to add the fiber water to dry kibble (of the "gravy" forming type) or even stir it into canned dog food. Because **fiber-water** is essentially flavorless, it is well tolerated by dogs. Cats also have serious dehydration and constipation problems. Cats are obligate carnivores and generally will not knowingly

consume fruits or vegetables (other than valuable houseplants). Kidney failure is a common malady of geriatric cats resulting, in part, from inadequate hydration. Constant vomiting is a common feline problem brought on by their grooming during which they ingest significant quantities of fur. In the wild cats ingest sufficient indigestible matter (bones, cartilage and tendons) to provide non-vegetable "fiber." With pet cats the owners are expected to mix fiber (generally psyllium) with the cat's food or administer petroleum-based laxatives. Neither alternative is particularly ideal. **Fiber-water** can be given as water or mixed with the cat's food to provide sufficient fiber to prevent both hairballs and constipation thus solving significant feline problems. It appears that reduction in vomiting positively contributes to the hydration of cats.

#### Example 1

It has been estimated that adult fiber requirements are between about 10 grams and about 40 grams per day. Some experts have adopted a figure of around 25 grams. Obviously, the requirement for fiber is related to body size, weight and health status. Some attempts have been made to relate the requirement to weight. It has been estimated that between 50 and 300 mg. of fiber per kilogram of body weight per day. Fiber requirements can also be estimated from daily caloric intake. Current estimates call for about 25 grams per day for a 2,000 calorie diet (adequate for a 125 pound person) and about 37 grams for a 3,000 calorie diet (adequate for a 175 pound person). Both approaches yield roughly similar results since a heavier person usually has a greater caloric intake. These estimates should provide adequate fiber for even a person with a very fiber deficient diet. On the other hand, should a person experience signs of excess fiber ingestion, it is easy to decrease the intake of **fiber-water**.

Taking a 25 g of fiber per day requirement and using the rubric of 8 glasses of water (each glass equals approximately 250 ml of water) one should spread the 25 g over 2,000 ml (8 x 250 ml). Therefore, the **fiber-water** used should contain 12.5 mg/ml of

soluble fiber or approximately 1.25 % by weight **fiber-water**. For a daily caloric intake of 3,000 calories this translates to a **fiber-water** of about 2% by weight soluble fiber.

This analysis indicates that at least two different "strengths" of **fiber-water** should be produced to allow a range of average persons receive both the optimum amount of water and fiber. In actual fact, it is convenient to produce a number of grades ranging from about 0.50% to 2.5%. This allow would a wide range of individuals to readily select a **fiber-water** drink that simultaneously supplies both the required amount of water and the required amount of fiber. Depending on individual needs and the desire to drink in relation to ability to drink the amount of fiber can be increased by using an appropriate "grade" of **fiber-water** to supply some or all of the required eight glasses of water. Of course, it is also possible that an individual does not intend to spread out the fiber requirement over eight 8 oz. glasses. It may be desirable to consume the fiber at home—in the morning and evening—and not a work. For this and similar reasons, it is desirable to make several more concentrated grades of **fiber-water** ranging from 5% to even 10% by weight fiber to reduce the number of daily doses needed. Thus, if one does not have **fiber-water** available all day, hydration can be assured by drinking plain water supplemented by a higher "grade" of **fiber-water** to reach the fiber requirement. If necessary, the amount of fiber consumed can be reduced by using a lower "grade" of **fiber-water**—or even just plain water—for some of the required eight glasses of water. It may also be advantageous to add a different food color to each grade so that the "strength" of the **fiber-water** can be identified at a glance. Colors can be used to indicate different levels of fiber in the liquids.

Test **fiber-water** according to the above scheme was produced by dissolving the required weights of a mixture of indigestible dextrins and partially hydrolyzed guar gum in purified water. The preferred dextrins or maltodextrins are prepared by controlled hydrolysis of vegetable starches (*e.g.* potato or corn) as is described in U.S. Patent No. 5,620,873. The hydrolyzed guar gum is of the type discussed in U.S. Patent No.

5,260,279 (available in the United States as BENEFIBER® from Novartis Nutrition of Minneapolis, MN; available in other countries as SUN-FIBER® from Taiyo of Japan). The resulting solution, in the strengths explained above, is essentially colorless and clear having the basic appearance of plain water. The liquid is either flavorless or may have a very slight "sweetness" depending on the strength of the particular solution and the proportion of the soluble fibers used. The partially hydrolyzed guar gum is essentially flavorless while the maltodextrin has a slight sweet taste. In addition, some individuals can detect a slightly different "mouth feel" because of the slight viscosity increase resulting from the soluble fibers.

10           However, for all practical purposes the resulting solution looks and behaves like bottled water and can readily be used in place of bottled water. If it is desired to ensure the microbial status of the **fiber-water**, it can be autoclaved or sterile filtered like plain water. Starting with a good quality drinking water preferably one with little or no sodium can ensure palatability. Addition of trace of "essence" or flavor such as lime or lemon can enhance palatability without adding any calories or otherwise detracting from the beneficial properties of the product. The product should look, behave and be used like high quality drinking water. To this end any "naturally occurring" water can be used as a starting. Thus, it is possible to start with a mineral water and produce "fiber mineral water." Such mineral waters may have up to 500 mg/l of dissolved salts. However, the present invention does not include sugar or salt laden beverages such as isotonic or "sport" beverages. These are specialized beverages that inappropriate for the near universal applications intended for **fiber-water**.

#### Example 2

25           Infants also have distinct fiber requirements. Until recently, no specific guidelines for dietary fiber in children were available. Recommendations have recently been developed, based on age, weight and height of the child. It is now recommended that

children older than two years consume a minimum amount of fiber equal to the age plus five grams a day. The recommended "safe dose" is between this and age plus ten grams a day. Above that symptoms of excess fiber (*e.g.*, loose stool) may become apparent. It is the intent of the various grades of fiber-water provided in the present invention to enable a person or a caregiver to "titrate" the amount of fiber by looking for symptoms of excess fiber consumption. Since infants and small children are generally unable to directly tell us of their digestive distress, constipation and other results of inadequate fiber are often exhibited as fussiness or similar undesirable behavior. This is especially true when infants are just being weaned from fiber-free milk to a fiber containing diet. There can be significant advantage to providing a fiber source in the water consumed by the infant. Because infants have a constant requirement for water addition of **fiber-water** to the typical diet can provide a more constant, even source of fiber while ensuring adequate hydration. Further the use of **fiber-water** can ensure adequate fiber without adding significant calories—an inevitable consequence of other fiber sources. Consistent dietary fiber can provide for more even operation of the infant's digestive process. In contrast, a more traditional infant diet that alternates between low fiber formula and high fiber "adult" foods may have an uneven or cramping effect.

A useful amount of soluble fiber is 1/4-1 gram per 8 oz (considerably lower concentration than for the adult **fiber-water**). The "baby **fiber-water**" is produced by dissolving the required amount of soluble fiber consisting of a mixture of partially hydrolyzed guar gum and inulin (FRUTAFIT® from Imperial-Sensus of Sugar Land, TX is a preferred inulin for this purpose) in safe (*e.g.*, purified) water. The slight sweetness of the inulin makes the water especially palatable. The intent here is not to treat any specific diseases but to ameliorate constipation—and thus disease states known to cause constipation. For example, Hirshprung's syndrome is caused by a loss of motor cells in the lower rectum; therefore there is a loss of thrust. Children born with congenital problems or children still suffering from incompletely healed accidents benefit from **fiber-**

water that provides bulk and hydration to help overcome serious constipation that may result from such causes. Actually babies are extremely sensitive to a variety of stresses and changes and get constipated as a result. Alternating bouts of regularity and or constipation is not uncommon. A baby's system may be under stress and that alone can be the cause. Infants can sense stress in their surroundings be it the home, etc.:

- Dysfunctional homes where there is divorce, alcoholism, family abuse etc., may be noted in the babies refusal to eat, defecate, crying spells etc.
- Changes in custodial care baby sitters, new sibling, and or step parent etc.
- Changes due to normal childhood illnesses, colds, flu, teething, fever, measles, mumps, chicken pox, etc. While these illnesses may not be the direct cause of constipation they may be the indirect cause. With illness come changes in eating, sleeping, behaviors, and habits.
- Travel—when a babies environment is changed, from going to grandparents to international travel, sensitivities to the new can throw off a system that is used to regularity. International travel bears with it the dehydration of long hours on an airplane etc. The future holds even more stressing travel such as space travel.
- Accidents-also upset regular habits and can result in constipation.

Water probably can be given as early as one month, although usually started between 2-4 months after birth. In some instances **fiber-water** may be of especially significant value. **Fiber-water** can serve as a great pacifier without the dangers of dental harm posed by traditional formula or beverages. Diarrhea, which is often caused by contaminated water supplies, can be life threatening to infants. Therefore, there are great advantages to using safe bottled water for any infant formula, etc. Using safe packaged **fiber-water** is even better where it is desired to avoid excessive caloric intake. In the case of the "fat baby" the **fiber-water** may well due more than provide a low or on calorie hydrating agent. The soluble fiber in **fiber-water** has been show to slow the absorption of fats and sugars. Therefore, the **fiber-water** may also help to counteract an overly rich diet.

As the infant becomes a toddler and moves towards more a more adult diet, the requirement for fiber increases. **Fiber-water** again serves as the ideal source of both hydration and fiber. Unlike soft drinks or fruit juices **fiber-water** does not add calories to the diet nor does it cause dental caries. It is most convenient to package toddler/young child **fiber-water** in flexible pouches or laminate boxes because these containers are shatter proof and can be easily used by small children. As with adult **fiber-water**, it is advantageous to provide the infant and child **fiber-water** in a number of "grades" so that the amount of fiber administered can be readily adjusted. Again, it is advantageous to add identifying color so that it is apparent to the parent precisely which grade of **fiber-water** is being used. In the case of children the color is inherently appealing and may mitigate in favor of using transparent packaging so that the child can appreciate the color of the **fiber-water** being consumed.

It is permissible and often advantageous to blend an assortment of different soluble fibers to create any particular **fiber-water**. It is believed that the various soluble fibers have essentially identical properties when it comes to providing bulk and hydration to the

stools. However, it is not yet clear which soluble fibers will prove superior in altering lipid or sugar absorption. Of the soluble fibers presently available the indigestible dextrins, inulins and partially hydrolyzed guar gum appear to provide the most "water clear" solutions. However, many dextrins and inulins contain a small amount of a metabolizable component and have a slight sweet taste. Therefore, there can be an advantage of providing a portion of the soluble fiber in the form hydrolyzed guar gum or some other flavorless and totally non-metabolizable compound. Even though some of these materials may produce a less clear solution, a combination with a "clear" soluble fiber can yield a solution that is both high in fiber and clarity and low in sweetness or other taste. Other soluble fibers can be combined to realize the advantages of the different fibers. Inulins have a slightly sweet taste and while not appreciably metabolized by humans, bacteria in the colon metabolize inulins. In some cases such colonic metabolism may provide a distinct advantage and would mitigate towards including inulins in the mixture. Until the advent of **fiber-water** the advantage of a clear or nearly clear soluble fiber was not appreciated. As mentioned above, it is anticipated that partial hydrolysis and fractional refining of the various soluble fibers mentioned above will rapidly lead to a greater variety of "water clear" soluble fibers.

The present invention discloses the hitherto unappreciated advantages of using **fiber-water** as an essentially non-caloric source of fiber and water. In other words a new dietary component that simultaneously provides hydration and dietary fiber. While the examples have dwelt with prepackaged **fiber-water**, there is nothing that precludes **fiber-water** from being prepared by the end user from a concentrated source of soluble fiber and potable water. The soluble fiber can be in the form of a powder or a slurry/suspension or a concentrated solution or syrup to which a predetermined quantity of water is added. In the past such fiber sources have been added to solid food items and to various beverages. However, such concentrated sources of fiber have never been used to prepare potable **fiber-water** for direct consumption as water

In addition to the equivalents of the claimed elements, obvious substitutions now or later known to one with ordinary skill in the art are defined to be within the scope of the defined elements. The claims are thus to be understood to include what is specifically illustrated and described above, what is conceptually equivalent, what can be obviously substituted and also what essentially incorporates the essential idea of the invention. Those skilled in the art will appreciate that various adaptations and modifications of the just-described preferred embodiment can be configured without departing from the scope and spirit of the invention. The illustrated embodiment has been set forth only for the purposes of example and that should not be taken as limiting the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.